

Freshwater Quality Monitoring Protocol
San Francisco Area Network

Standard Operating Procedure (SOP) # 12

SITE SELECTION & DOCUMENTATION

Version 1.0

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Revision History Log:

Prev. Version #	Revision Date	Author	Changes Made	Reason for Change	New Version #

Only changes in this SOP will be logged. “Version numbers increase incrementally by hundredths (e.g. version 1.01, version 1.02, ...etc) for minor changes. Major revisions should be designated with the next whole number (e.g., version 2.0, 3.0, 4.0 ...). Record the previous version number, date of revision, author of the revision, identify paragraphs and pages where changes are made, and the reason for making the changes along with the new version number” (Peitz et al, 2002).

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Acknowledgements

O’Ney SE. 2005. Initial Site Establishment, Version 1.0, Standard Operating Procedure #1. *In* Regulatory Water Quality Monitoring Protocol, Version 1.0, Appendix E – SOPs, National Park Service, Greater Yellowstone Network. Bozeman, MT. 37 pp. plus appendices

1.0 FIELD PREPARATIONS AND SITE SELECTION

1.1 Permission and Access

Some sites are located on private lands or local or state government lands. In these cases it is necessary to obtain some form of permission. This may range from a phone call notifying the landowner of a sampling event to obtaining a permit. For example, California State Parks require a permit. Be sure to consider not only the site location but also the access route. Although a site may be on National Park lands, a road, trail, or parking outside Park lands may be required to access the site.

Other agreements include a Memorandum of Understanding (MOU) with other agencies that are conducting monitoring on parklands. This can be useful in setting guidelines, study boundaries, and coordinating efforts. A MOU with the San Francisco Bay Regional Water Quality Control should be established in order to coordinate I&M monitoring efforts with the Surface Water Ambient Monitoring Program (SWAMP) efforts.

On both National Park and private lands site access may require a key or combination to a lock. Contact a park representative or landowner when necessary.

1.2 Site Selection

Sampling locations have been described in tables and maps in the Appendix D through F of the Protocol Narrative. The purpose of the site location descriptions is to provide the individual with enough information to drive or walk to a site. The tables also indicate the time of data and type of habitat (flowing or standing water) to be sampled. However, the exact place to collect samples is not specified. To establish sites follow the tips in the following section.

1.2.1 Tips for Site selection

(Adapted from O’Ney, 2005)

- ◆ Avoid culverts since streams may be impacted by roads and trails; in most cases establish a site at least 20 m upstream of a culvert. This reduces the affect of the road. For large roads and/or water that is “backed-up” against the culvert or bridge; move site further upstream.
- ◆ Verify each site using GPS where possible and attention to maps and access directions
- ◆ Safety and access (ie., not only how to get to the stream, but how to reach the sample site). The most common hindrances to site access are steep banks and dense stands of poison oak, blackberry and stinging nettle.
- ◆ Consider appropriate locations for measuring flow. Straight channel reaches where flow is uniform are ideal.
- ◆ Consider the monitoring objectives and questions, types of data needed, equipment needs, and sampling methods (see the site location tables; also see the table of monitoring questions and related sampling location (habitat), and time of day).
- ◆ Obtain all available historical information on the site location.

- ◆ Sites immediately upstream or downstream of tributaries or point sources should also be avoided to minimize problems caused by backwater effects or poorly mixed flows. Typically, a distance of 5 stream widths below the influence of a tributary is adequate distance to ensure mixing. Complete vertical and lateral mixing within the cross section is generally desirable.
- ◆ Samples collected directly downstream from a bridge should be avoided, as they can be contaminated from the bridge structure or runoff from the road surface.
- ◆ Access to any sampling site is directly related to monitoring program cost. Bridges are frequently chosen for establishment of water quality monitoring stations due to access during most flows and they permit sampling at any point across the stream width. Samples should be collected upstream of the bridge.
- ◆ Monitoring of turbulent streams or during peak flows can be a safety concern for monitoring personnel. Monitoring locations should be chosen that allow sampling at peak flow with minimal risk to sampling personnel.

1.2.2 Randomization in Site Selection

Stream selection and site locations within a stream have been selected judgmentally for a variety of reason described further in the Protocol Narrative. It is important to have some level of randomness incorporated into the water quality sampling regime. Within a flowing water or standing water area, the exact sampling spot can be chosen randomly. It is helpful to sketch the pool or riffle/run first. Then, using a random number table, choose two numbers to represent the width and length of the sampling spot from the edge of the pool or riffle/run. Where these intersect is the sampling location.

2.0 SITE DOCUMENTATION

2.1 Establishing a Preliminary Profile of Field Measurements

(from O’Ney, 2005)

After a tentative selection of a sampling site is completed, the next step is to develop a preliminary profile of required field measurements (discharge, temperature, dissolved oxygen, conductivity, pH) at various locations along the cross section. The field measurement profile is used to indicate reach homogeneity. To obtain data representative of the section, the variability of discharge and field measurements across the stream must be known (NPS, 2003).

To establish a profile of field measurements:

1. Establish a cross sectional profile of stream discharge (see SOP #9 – Field Methods for Flow Measurements).
2. Check the cross-sectional profile data of the stream site to determine the variability of discharge per unit width of the stream.
3. Determine the increment (vertical) at which discharge in that increment is equal (approximately) on both sides of that point. This is the centroid of flow, and the point at which measurements for core parameters should be obtained.
4. Make individual measurements of required field parameters (temperature, dissolved oxygen, pH and conductivity) at a number of equally spaced verticals along the cross section and at multiple depths within each vertical.
5. Check the cross-sectional profile data to determine the variability of core field parameters per unit width of the stream.
6. Field-measurement profiles of stream variability are needed for low- and high-flow conditions and should be verified at least every 2 years.
7. Record the information collected in 1-5 above. Include in Field Folders for each station.

If the cross sectional profile of stream discharge and field measurements indicates that the section is not homogeneous, then repeat the procedure at additional locations until a suitable site has been identified.

2.2 Obtaining Station Coordinates

(Adapted from WY-DEQ, 1999):

After determining the station location, use GPS equipment to obtain station coordinates. GPS locational data are collected by GRYN field technicians for each monitoring station. Readings are taken near the water’s edge. Technicians record the GPS field file, GPS start time and stop time, GPS latitude/longitude coordinates, and after the files are processed, fill in the corrected latitude/longitude coordinates on the Field Data sheet. After the GPS field files are differentially corrected, the locational data are entered onto NPSTORET station files, Field Data sheets and field log books. All GPS data files will be sent electronically to the GRYN Bozeman office to be archived.

Field technicians are referred to the GRYN Data Manager for details on using GPS equipment and software. On-line training is available. The GRYN should provide initial and refresher training as necessary.

2.3 Photographic Documentation

Develop a standardized naming system for the photographs such as site ID and direction. Photographic documentation has many purposes and one of them is to track site changes over time. For this purpose, we want to document periphyton, riparian cover, location and extent of gravel bars

(Adapted from WY-DEQ, 1999):

Each sampling site must be documented with a series of photographs to establish site conditions. These photographs will be used to accurately relocate monitoring sites and to document field conditions. Individual photographs are taken looking upstream and downstream from the base of the sampling reach.

Photographs should be identified with:

- The photograph number, frame and/or roll;
- Date and time, even if the photographs are automatically date stamped by the camera;
- The subject;
- The location in narrative format and lat/long coordinates;
- The photographer;
- Witnesses, if any;
- The location from which the photograph was taken; and
- A short narrative related to the photographs

New photographs should be taken at the beginning of each field season (i.e., summer/fall before the next water year), and whenever site conditions change significantly.

2.4 Establishing NPS-STORET project files

(from O’Ney, 2005)

Field personnel are responsible for establishing and maintaining electronic and paper project and site files. NPS policy requires specific information on surface water sampling sites. Technicians are referred to <http://science.nature.nps.gov/im/monitor/protocols/wqPartE.doc> for detailed discussions of NPS data and metadata requirements, and to Data Management Procedures (SOP#8) of this protocol for detailed instructions.

Project files should be established prior to site reconnaissance visits, using the NPSTORET database template. Project, station, and metadata information are only entered once (unless a new project is started, new stations are added, or procedures change). All monitoring results collected at stations are assigned to projects. For Project ID, enter SFAN followed by WQ to indicate that it is a water quality project and then a sequence number (e.g. the first project in the

Network would be SFANWQ01). Most of the information entered about the Project on the Main and Additional Info tabs should be readily available in network planning documents. You can paste in relevant information directly from a monitoring plan or other document. Additionally, the entire document can be stored as an Adobe Acrobat PDF file in the database (Documents screen) to permanently associate important reference material directly with the data. Other references (entered in the Metadata template) can be associated with the project on the Citations tab.

Refer to Data Management Procedures in the protocol narrative for the minimum information required for establishing electronic project files in NPS-STORET, and details for entry.

2.5 Entering Station Information in NPSTORET

Prepare a description of the location, and compile other required information (including digital photograph) for establishing NPS-STORET files. Upon returning to the office, enter all information into the SFAN water quality database. Some example station IDs are included in Table 1.

Table 1. Station IDs for water quality sampling locations

Waterbody	Location Description	Station ID
Chalone Creek	South wilderness,	PINN_I&M_CHA1
Gerbode Creek	Above Rodeo Creek confluence	GOGA_I&M_ROD6
Olema Creek	At Bear Valley Rd. bridge, upstream	PORE_I&M_OLM11
Franklin Creek	Franklin Creek at JOMU bridge	JOMU_I&M_FRA1

The NPSTORET site naming convention for Station ID's is:

Park Code_Project Grouping_Station name/abbreviation/code

STORET allows station Ids with up to 15 characters. For old station ideas, most systems allow you to carry along secondary station names so those names can be preserved.
Works well for sorting stations

2.6 Entering Additional Information Into NPSTORET

In addition to the information required for site establishment, information must be entered related to the parameters collected at each site (see Tables 1 and 2, below). See the SFAN Quality Assurance Project Plan (SOP #4) and Protocol Narrative for additional information.

2.7 Creating Field Folders

Selected information that is needed for reference while at a sampling station is kept in a field folder. The field folder contains information needed by trained personnel to locate and safely collect and process water quality samples, and is taken along on each sampling trip. Assemble a field folder for each sampling station to contain the following:

- Station description:
 - Location of gaging station (if one is present) and USGS contact information.
 - Location of sample-collection sites. Actual sampling locations may differ slightly depending on flow conditions.
 - Hydrologic and geologic maps, if available.
 - Name of landowner, tenant, or other responsible party.
 - Current copy of research and collection permit (if site located within NPS boundaries)
 - Site access instructions (for example, call owner or site operator before arrival at site, obtain key to unlock security gate).
 - Photographs to document site conditions.
- Maps to site (state and local)
- Profiles of cross section of stream channel at sampling locations
 - Stream bottom geometry
 - Physical and chemical measurements
- Safety information (SOP#3):
 - Nearest emergency facilities.
 - Phone numbers (home) of project manager or supervisor.
 - Traffic condition and traffic plan showing where to park, placement of flags and cones.
 - Location of power lines.
 - Environmental hazards, such as weather and animals.
- Sampling schedule
 - Laboratory analyses to be requested and associated codes
 - When to collect samples
 - Bottle types needed for each analytical schedule
- Sampling instructions:
 - Discharge curves and velocity cross sections
 - Discharge rating curves and/or tables
 - Preservation, storage, and handling requirements
 - Quality control sample requirements
- Shipping instructions (if applicable)
 - Amount of ice to use and holding time requirements
 - Mailing labels to and from laboratory
 - Location of nearest post office or shipping agent
- Field forms and examples of completed forms for both required and regulatory field parameters:
 - Analytical service request forms

- Permission forms and data collection forms
- Laboratory Chain of Custody Forms including proper dilutions for fecal indicator bacteria samples.
- Equipment check lists
- Other local information including park contacts, local advisories (fire, flood, landslide, rock fall, problem exotics), etc.

3.0 EQUIPMENT INSTALLATION

3.1 Installation of a Staff Gauge

(Adapted from USGS, 1999)

For recurring discharge measurements at a monitoring location, it is usually best to install a staff gage (non-recording) in the absence of any nearby automated (recording) gaging station. A staff gage is a scale (usually enameled steel) placed in a stream to show the elevation of the water surface. It is calibrated by referencing the numbered height on the gage to the surveyed elevation of the water surface and its associated flow at the time of installation. A rating curve or stage-discharge relationship is then developed from numerous stage measurements and discharge computations made at the site during variations in flow by plotting stage versus discharge (typically gage height in feet versus discharge in cubic feet per second) on log-log paper. The more points, the more precise the rating curve is likely to be.

Vertical staff gages are used as reference gages for setting a recording device. The vertical staff gage can be used in a stilling well or in a stream. Standard staff gages should be purchased, and installed on a 4x4 post (or affixed to a permanent structure such as a bridge) adjacent to the sampling station. The staff gage should be located in an area that will provide some degree of protection from debris flows, etc. The staff gages installed at specific water monitoring locations will be read at the time water samples are taken to determine the stage or elevation of the water surface at that location. Anchored in the stream bed, the gage will consist of a vertical scale that is permanently marked in increments of 0.01 feet and the stage reads directly from these markings to the nearest 0.01 feet. Stream stage is defined as the elevation of the water surface above an arbitrary zero datum at that specific point in the stream. Thus, the zero discharge point does not necessarily correspond to a stage of zero.

3.2 Installation of an Automatic Stage Recorder and Establishing a Rating Curve

Measuring continuous discharge requires the installation of a pressure transducer and electronic data logger in conjunction with the staff gage. A Keller pressure transducer and Campbell Scientific data logger are recommended, however, there are numerous other pressure transducers and data loggers that would also be adequate (O/Ney, 2005). SFAN currently uses Druck and Global Water pressure transducers. Follow the operating instructions provided by the manufacture.

The best way to install the pressure transducer/data logger in surface water is to use a 2" pipe to protect the sensor and the data logger. You can use PVC schedule 40, or ABS sewer drain pipe. The best protective pipe is PVC schedule 40 electrical conduit. This light grey pipe has UV protectors and pre-formed "sweeps" or bends which enable the pipe to conform to the contours of the river bank. The sensor will slide down through 45 or 90 degree sweeps. The pipe may be buried in the river bank, secured with rocks, or fastened to the bank with large staples made by bending pieces of concrete reinforcing steel in half and driving them into the bank. The pipe should have several large (1/2" diameter) holes drilled near the sensor location in order to eliminate velocity effects on the sensor. Also, a smaller 1/4" hole should be drilled near the top of the pipe to allow air movement when the water goes up and down. A standard slip cap or a

locking well cap can be used to protect the top of the data logger. You can also adapt the pipe for a screw-on cap.

Depending on site conditions, it may be more appropriate to install the sensor and data logger in a stilling well. Various kinds of automatic stage recorders can be set up in stilling wells. A stilling well is a chamber that is hydraulically connected to the stream through intake pipes. The stilling well eliminates turbulence that may occur in the stream and the elimination of waves and surges results in more accurate readings. Manufacturers' instructions are followed for the specific installation and operation.

The next step is to establish a rating curve by making a series of independent flow measurements and simultaneous staff gage measurements for that station at different water levels using the velocity-area method (see Field Methods for Measurement of Core Parameters, SOP#5). The rating curve converts stage height to discharge. Discharge measurements using the velocity-area method should be made over a range of stage heights. Discharge rating curves are usually determined empirically by means of periodic measurements of discharge and stage using a current meter (minimum of 10 per year is recommended initially). However the rating curve may shift over time and periodic measurements are necessary after the first year to either confirm the permanence of the rating or to follow changes/shifts in the rating. It is important that the rating curve include measurements made at flow extremes (e.g. flood conditions) and under ice conditions to be most accurate. Volume 2 of USGS WSP 2175 (Rantz et. al., 1982) discusses stage-discharge relations ranging from simple to complex and the various parameter variables (slope, velocity index) that should be considered when computing discharge rating curves under more complex situations.

It is recommended that for at least the first year of sampling, discharge measurements be taken for each sampling event, to help establish a reliable stage/discharge relationship.

4.0 REFERENCES

- National Park Service. 2003. Vital signs long-term aquatic monitoring projects: Part C, draft guidance on WRD required and other field parameter measurements, general monitoring methods and some design considerations in preparation of a detailed study plan, (work in progress)", August 6, 2003. Draft. Available at:
<http://science.nature.nps.gov/im/monitor/protocols/wqPartC.doc>
- National Park Service. 2004. Part E: Draft guidance on data archiving and reporting in STORET. Available at <http://science.nature.nps.gov/im/monitor/protocols/wqPartE.doc>
- O'Ney SE. 2005. Initial Site Establishment, Version 1.0, Standard Operating Procedure #1. *In* Regulatory Water Quality Monitoring Protocol, Version 1.0, Appendix E – SOPs, National Park Service, Greater Yellowstone Network. Bozeman, MT. 37 pp. plus appendices
- Rantz, SE., and others. 1982. Measurement and computation of streamflow, Volume 1, measurement of stage and discharge: U. S. Geological Survey Water Supply Paper 2175. 284 p.
- U.S. Geological Survey, variously dated, National field manual for the collection of water-quality data: U.S. Geological Survey Techniques of Water-Resources Investigations, book 9, chaps. A1-A9, available online at <http://pubs.water.usgs.gov/twri9A>
- Wyoming Department of Environmental Quality. 1999. Manual of Standard Operating Procedures for Sample Collection and Analysis. Available at <http://deq.state.wy.us/wqd/watershed/10574-doc.pdf> Accessed 08/02/04.